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National Priority Chemicals Trends Report (2000-2004)

Section 4
Chemical Specific Trends Analyses for Priority Chemicals (2000−2004): Polycyclic Aromatic Compounds (PACs)

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Polycyclic Aromatic Compounds (PACs)

Chemical Information:

PACs, also known as polycyclic aromatic hydrocarbons (PAHs), are a group of more than 100 different chemicals that are characterized by hydrogen and carbon arranged in two or more fused benzene rings. As pure chemicals, PACs generally exist as colorless, white, or pale yellow−green solids. Most PACs are found as a mixture of two or more PACs. The TRI PAC group includes the following chemicals: benzo(a)Anthracene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(j,k)fluorine, benzo(k)fluoranthene, benzo(rst)pentaphene, benzo(a)Phenanthrene, benzo(a)pyrene, dibenz(a,h)acridine, dibenz(a,j)acridine, dibenzo(a,h)Anthracene, dibenzo(c,g)carbazole, dibenzo(a,e)fluoranthene, dibenzo(a,e)pyrene, dibenzo(a,h)pyrene, dibenzo(a,l)pyrene, dimethylbenz(a)Anthracene, indeno[1,2,3−cd]pyrene, methylcholanthrene, methylchrysene and nitropyrene

General Uses − Most, if not all, PACs are byproducts of combustion or impurities and not created for use themselves. PACs may be formed as byproducts of both human and natural activities. They are produced or emitted during thermal processes such as the incomplete combustion of organic compounds, pyrolysis, or the processing of fossil fuels, bitumens, or nonfossil fuels. There are presently no known commercial uses for PACs. In the past, some PACs were produced in small quantities for research purposes or used in medicines or in the production of dyes, plastics, or pesticides. Other industrial contributors are the aerospace industry, coke ovens (various activities), petroleum refining, and primary aluminum production. PACs are used to conduct research, and to make dyes, plastics, pesticides and medicines.

Potential Hazards − PACs are harmful by ingestion, inhalation and skin absorption. In addition, most PACs emit toxic fumes when heated to decomposition. Many PACs have caused tumors in laboratory animals that were exposed to the chemicals through their food, from breathing contaminated air, and when the chemical was applied to their skin. Although there are no human data that specifically link exposure to PACs to human cancers, PACs are a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions and cigarette smoke.

Summary Analysis:

- NATIONAL: In 2004, 684 facilities reported approximately 13.8 million pounds of PACs. Compared to the quantity reported in 2000, there was a decrease of approximately 2.8 million pounds or approximately 17 percent in 2004.
- REGIONAL: Facilities in Regions 4 and 6 reported 84 percent of the total quantity of PACs in 2004.
- STATES: From 2000 to 2004, facilities in almost every state and territory reported PACs. Facilities in 10 states accounted for 90 percent of the total quantity in 2004. Facilities in four of these states (Texas, Louisiana, Tennessee, and Kentucky) reported approximately 69 percent of the total quantity.
- FACILITIES: Of the 684 facilities that reported PACs in 2004, six facilities reported approximately 56 percent of the total quantity of this chemical; 19 facilities reported approximately 88 percent of the total quantity.
- MANAGEMENT: In 2004, facilities used energy recovery and treatment to manage approximately 92 percent of the PACs.
- INDUSTRY SECTORS: From 2000 to 2004, facilities in 133 industry sectors reported PACs; facilities in 86 of these industry sectors reported PACs in 2004. Exhibit 4.189 shows the quantity of PACs for the 10 industry sectors in which facilities reported 95 percent of these chemicals in 2004.

National Trends:

Exhibit 4.179 shows the number of facilities that reported PACs in 2000 to 2004 and the quantities that were managed via disposal, treatment, energy recovery, and recycling. In 2004, 684 facilities reported approximately 13.8 million pounds of PACs. Compared to the quantity reported in 2000, there was a decrease of approximately 2.8 million pounds, or approximately 17 percent in 2004. The quantity of PACs steadily decreased from 2000 to 2003 but then increased by approximately 1.2 million pounds in 2004. Since 2000, the number of facilities that reported PACs increased slightly each year so that by 2004 an additional 58 facilities had reported these chemicals.

In 2004, facilities used energy recovery and treatment to manage approximately 92 percent of the PACs. Since 2000, energy recovery was primarily used to manage PACs; the steadily decreasing energy recovery quantities from 2000 to 2003 reflected the overall decreasing quantity of PACs. Treatment of PACs steadily increased since 2001. Disposal quantities decreased by approximately 64 percent since 2000 but increased by approximately 23 percent in 2004. Recycling of PACs has steadily decreased since 2000 – from approximately 3 million pounds in 2000 to 1.4 million pounds in 2004. Since 2000, recycling of PACs steadily decreased from almost 16.6 million pounds in 2000 to approximately 12.7 million pounds in 2003, an overall decrease of 55 percent.

Exhibit 4.179. National Management Methods for Polycyclic Aromatic Compounds, 2000−2004

Management Methods for PACs and Number of Facilities	2000	2001	2002	2003	2004	Percent Change (2000−2004)	Management Method − Percent of Quantity of This PC (2004)
Number of Facilities	626	664	644	673	684	9.3%	-
Disposal Quantity (pounds)	3,219,247	1,618,516	723,590	939,058	1,152,715	−64.2%	8.3%
Energy Recovery Quantity (pounds)	8,677,000	8,236,116	6,859,497	5,946,455	6,677,304	−23.0%	48.4%
Treatment Quantity (pounds)	4,673,803	4,227,491	5,191,965	5,769,728	5,979,074	27.9%	43.3%
Priority Chemical Quantity (pounds)	16,570,049	14,082,123	12,775,052	12,655,240	13,809,093	−16.7%	-
Recycling Quantity (pounds)*	3,014,337	2,750,150	2,431,817	1,711,810	1,362,226	−54.8%	-

*Note: Waste minimization is the emphasis of this Report. As such, we primarily focus on quantities of PCs that are managed via onsite/offsite disposal, treatment, or energy recovery because we believe these PC quantities offer the greatest opportunities for waste minimization. Because recycled quantities of PCs are already directed to their best uses, they are considered separate and distinct from the quantities of PCs not recycled. Throughout this section, the recycled quantity is presented to provide some perspective regarding the quantity of this PC already recycled compared to the quantities that are managed via disposal, treatment, and energy recovery and thus potentially available for waste minimization.

Exhibit 4.180 shows the number of facilities that reported PACs within various quantity ranges. Of the 684 facilities that reported PACs in 2004, six facilities reported approximately 56 percent of the total quantity of this chemical; 19 facilities reported approximately 88 percent of the total quantity.

Exhibit 4.180. Distribution of Quantities by Facilities Reporting Polycyclic Aromatic Compounds, 2004

PACs (13,809,093 pounds)		
Quantity Reported	**Number of Facilities Reporting This Quantity (2004)**	**Percent of Total Quantity of This PC (2004)**
up to 10 pounds	238	less than 0.1%
11 − 100 pounds	162	less than 0.1%
101 − 1,000 pounds	133	0.3%
1,001 − 10,000 pounds	89	2.2%
10,001 − 100,000 pounds	43	9.8%
100,001 − 1 million pounds	13	32.0%
> 1 million pounds	6	55.6%

EPA Regional Trends:

Exhibits 4.181 and 4.182 show the quantity of PACs reported by facilities in each EPA region in 2000 to 2004. Facilities in Regions 4 and 6 reported 84 percent of the total quantity of PACs in 2004.

Compared to the quantities of PACs reported in 2000, the quantity decreased in seven of the 10 EPA regions in 2004; decreases ranged from 30 percent in Region 8 to 99 percent in Region 10. Facilities in each of EPA Regions 4 and 10 reported decreases of approximately 2 million pounds. Conversely, facilities in Region 6 reported an increase of approximately 1.9 million pounds, compared to quantities reported in 2000.

Compared to the quantities of PACs reported in 2003, facilities in seven of the 10 EPA regions reported an increased quantity. Included among these increased quantities, facilities in EPA Regions 4 and 6 reported significant increases of 490,000 pounds and 744,000 pounds of PACs, respectively. Facilities in EPA Region 3 reported a decrease of approximately 161,000 pounds or 22 percent.

Exhibit 4.181. Regional Quantities of Polycyclic Aromatic Compounds, 2000−2004

EPA Region	2000 (pounds)	2001 (pounds)	2002 (pounds)	2003 (pounds)	2004 (pounds)	Percent Change in Quantity (2000−2004)	Percent of Total Quantity of This PC (2004)
1	185,086	546,054	618,076	611,571	618,569	234.2%	4.5%
2	218,104	159,033	144,086	160,372	123,909	−43.2%	0.9%
3	827,552	1,287,836	633,639	733,165	571,792	−30.9%	4.1%
4	6,593,109	4,724,638	2,088,158	3,622,996	4,366,887	−33.8%	31.6%
5	1,122,382	996,036	974,838	696,760	757,983	−32.5%	5.5%
6	5,308,010	5,220,874	7,626,243	6,696,407	7,186,841	35.4%	52.0%
7	26,634	28,108	13,079	32,452	34,488	29.5%	0.2%
8	156,567	127,706	54,675	62,894	109,333	−30.2%	0.8%
9	18,443	13,921	5,417	4,046	11,670	−36.7%	0.1%
10	2,114,163	977,916	616,841	34,579	27,620	−98.7%	0.2%
Total	**16,570,049**	**14,082,123**	**12,775,052**	**12,655,240**	**13,809,093**	**−16.7%**	**100.0%**

Exhibit 4.182. Distribution of Facilities Reporting Polycyclic Aromatic Compounds in 2004 and the Quantities of Polycyclic Aromatic Compounds Reported in 2004, by EPA Region

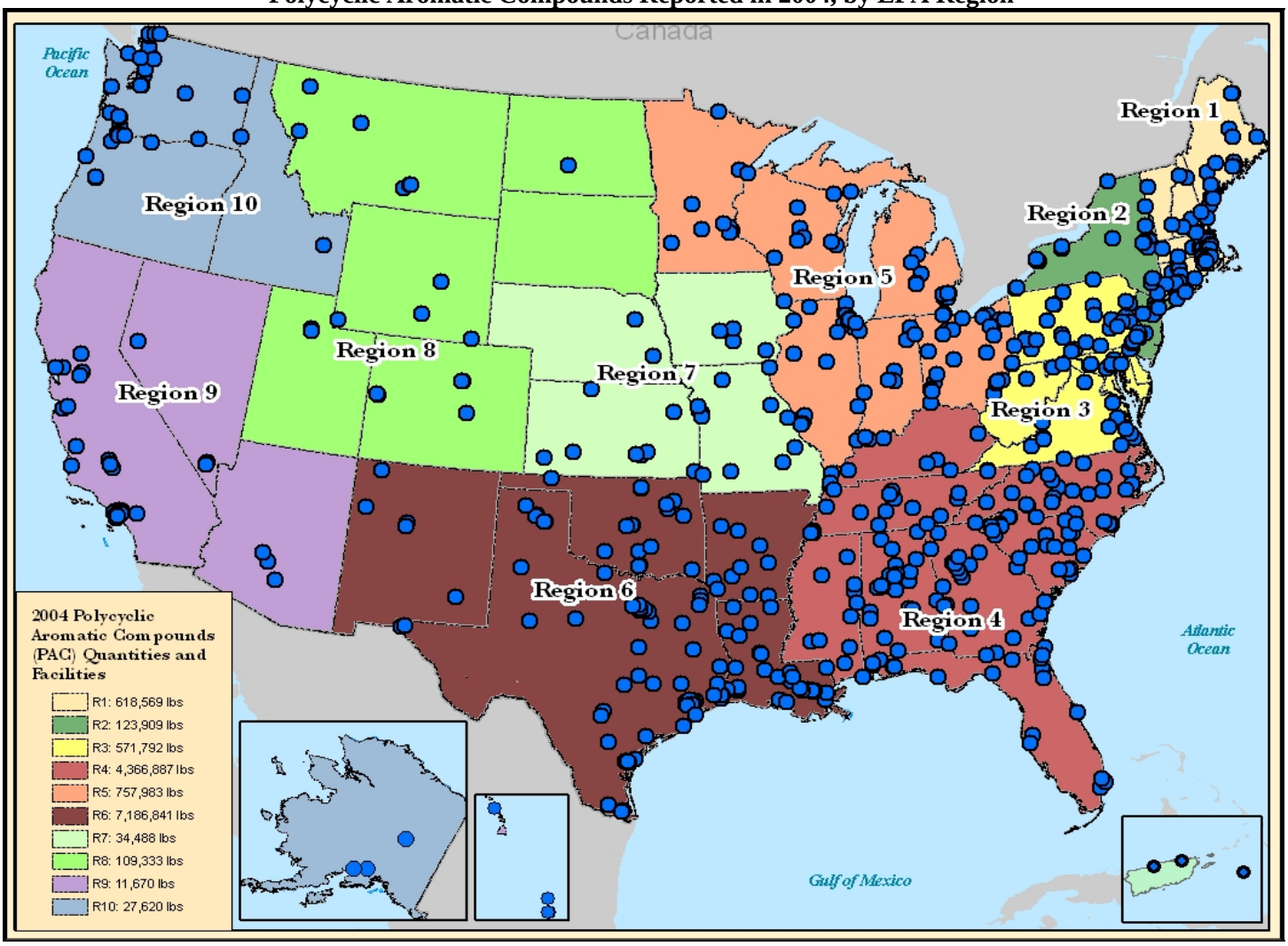


Exhibit 4.183 shows how facilities managed PACs, by EPA region, in 2004. Approximately 89 percent of the PACs were managed using onsite energy recovery and/or onsite treatment. Facilities in all but three EPA regions (Regions 3, 9, and 10) relied on these two methods to manage the majority of the PACs quantity. Facilities in EPA Regions 3, 9, and 10 used land disposal to manage 78 percent, 86 percent, and 49 percent, respectively, of their PACs quantity.

In 2004, these facilities recycled approximately 1.4 million pounds of PACs. Facilities in five EPA regions (Regions 3, 4, 5, 6, and 10) reported over 99 percent of the total recycled quantity; Region 6 facilities alone reported approximately 38 percent of the total quantity.

Exhibit 4.183. Regional Management Methods for Polycyclic Aromatic Compounds, 2004

EPA Region	Quantity (pounds) of PACs (2004)	Percent of Total Quantity of PACs (2004)	Disposal (pounds)		Energy Recovery (pounds)		Treatment (pounds)		Recycling (pounds)	
			Onsite Disposal	Offsite Disposal	Onsite Energy Recovery	Offsite Energy Recovery	Onsite Treatment	Offsite Treatment	Onsite Recycling	Offsite Recycling
1	618,569	4.5%	6,666	6,564	576,418	112	23,905	4,904	0	1,180
2	123,909	0.9%	632	25,029	3,901	449	89,531	4,367	3,979	105
3	571,792	4.1%	585	445,567	31	11,151	93,401	21,057	197,535	59,142
4	4,366,887	31.6%	27,983	158,618	2,141,893	63,956	1,950,083	24,353	225,816	30,512
5	757,983	5.5%	3,266	153,179	34,503	98,504	465,541	2,989	157,225	607
6	7,186,841	52.0%	2,114	290,617	3,586,567	50,652	3,218,223	38,667	282,567	238,064
7	34,488	0.2%	219	5,250	260	954	26,022	1,782	136	108
8	109,333	0.8%	1,322	1,423	103,722	2,567	98	201	655	0
9	11,670	0.1%	6,935	3,147	66	177	1	1,344	0	612
10	27,620	0.2%	1,440	12,158	130	1,289	12,323	280	163,395	589
Total	**13,809,093**	**100.0%**	**51,162**	**1,101,553**	**6,447,492**	**229,812**	**5,879,129**	**99,945**	**1,031,308**	**330,918**

State Trends:

From 2000 to 2004, facilities in almost every state and territory reported PACs. Exhibit 4.184 shows the quantities of PACs reported in the 10 states where facilities accounted for 90 percent of the total quantity of this chemical in 2004. Facilities in four of these states (Texas, Louisiana, Tennessee, and Kentucky) reported approximately 69 percent of the total quantity.

Compared to quantities reported in 2000, facilities in seven of these 10 states reported an increased quantity in 2004. These increases included 1.2 million pounds in Texas, 969,000 pounds in Kentucky, and 519,000 pounds in Maine. A decrease of 3 million pounds in Tennessee largely offset the increased quantities.

Compared to quantities reported in 2003, facilities in eight of these 10 states reported an increase in 2004, including an increase of 540,000 pounds by facilities in Tennessee.

Exhibit 4.184. State Quantity Trends for Polycyclic Aromatic Compounds, (Facilities Reporting 90 percent), 2004

State	Total Quantity (pounds) of PACs					Change in Quantity (2000−2004)	Percent Change in Quantity (2000−2004)	Percent of Total Quantity of This PC (2004)
	2000	2001	2002	2003	2004			
TX	2,401,016	2,435,035	3,403,118	3,312,687	3,591,540	1,190,523	49.6%	26.0%
LA	1,954,370	1,928,887	2,175,928	2,244,512	2,357,586	403,216	20.6%	17.1%
TN	4,843,397	3,223,956	555,317	1,274,029	1,813,901	−3,029,496	−62.5%	13.1%
KY	727,451	709,075	865,582	1,533,430	1,696,087	968,637	133.2%	12.3%
AR	811,269	630,017	749,267	824,374	1,049,691	238,422	29.4%	7.6%
ME	1,146	474,454	541,375	525,393	519,741	518,595	45253.1%	3.8%
IN	397,933	365,493	441,039	460,296	480,391	82,458	20.7%	3.5%
NC	495,362	231,354	221,772	385,129	357,623	−137,739	−27.8%	2.6%
WV	417,101	290,437	132,348	141,384	312,824	−104,276	−25.0%	2.3%
SC	205,398	208,708	165,023	257,340	257,494	52,096	25.4%	1.9%
Total	**12,254,442**	**10,497,415**	**9,250,770**	**10,958,573**	**12,436,877**	**182,435**	**1.5%**	**90.1%**

Exhibits 4.185 and 4.186 show the trends for the quantities of PACs for the top five states in which facilities reported this PC in 2004.

Exhibit 4.185. Texas, Louisiana, and Arkansas Trends for Polycyclic Aromatic Compounds, 2000–2004

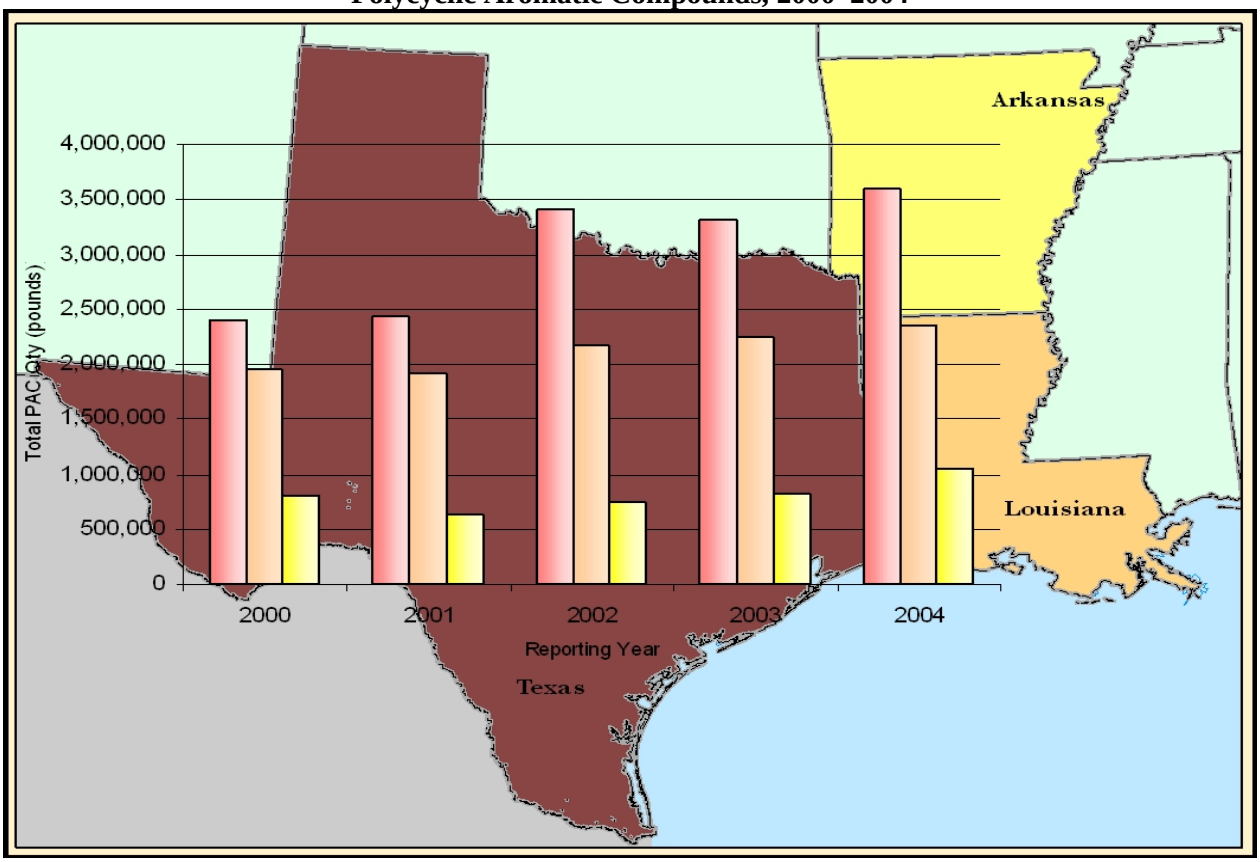
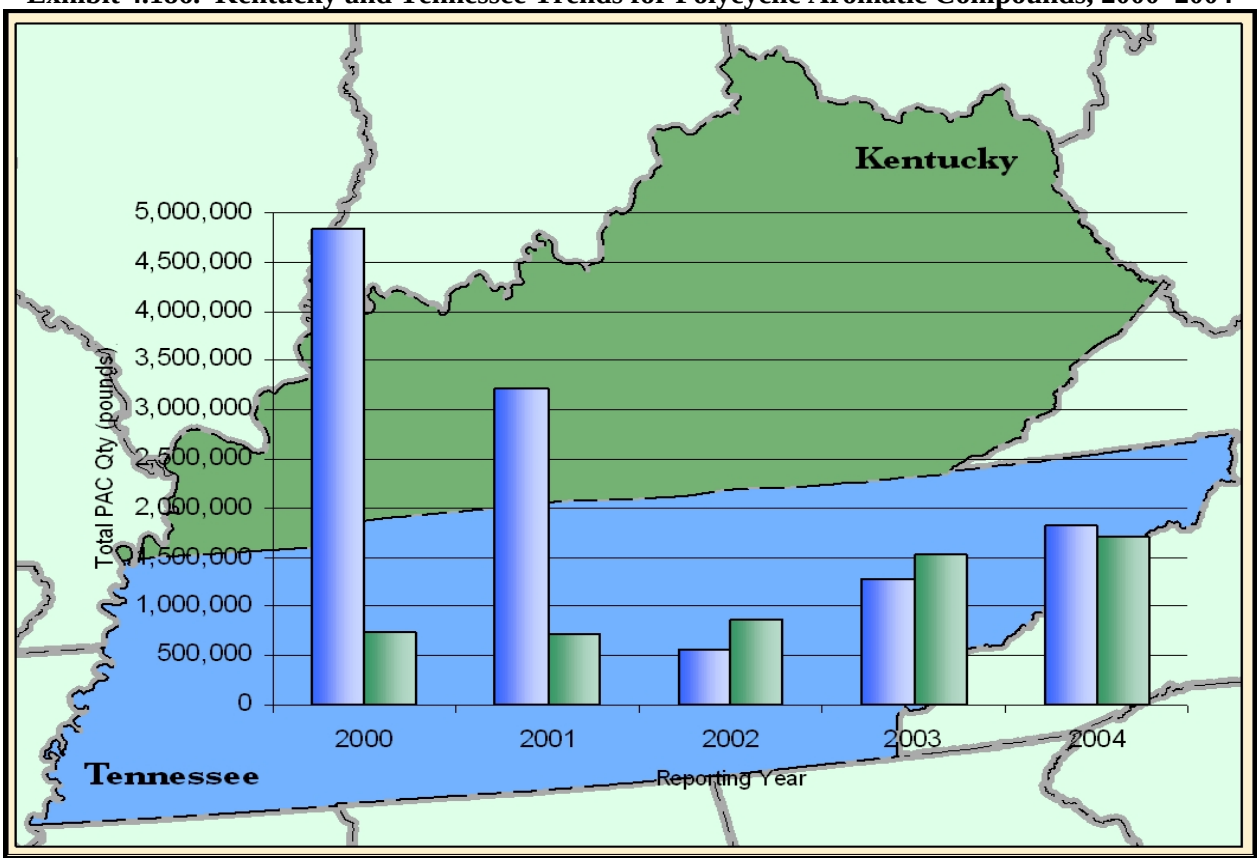


Exhibit 4.186. Kentucky and Tennessee Trends for Polycyclic Aromatic Compounds, 2000–2004

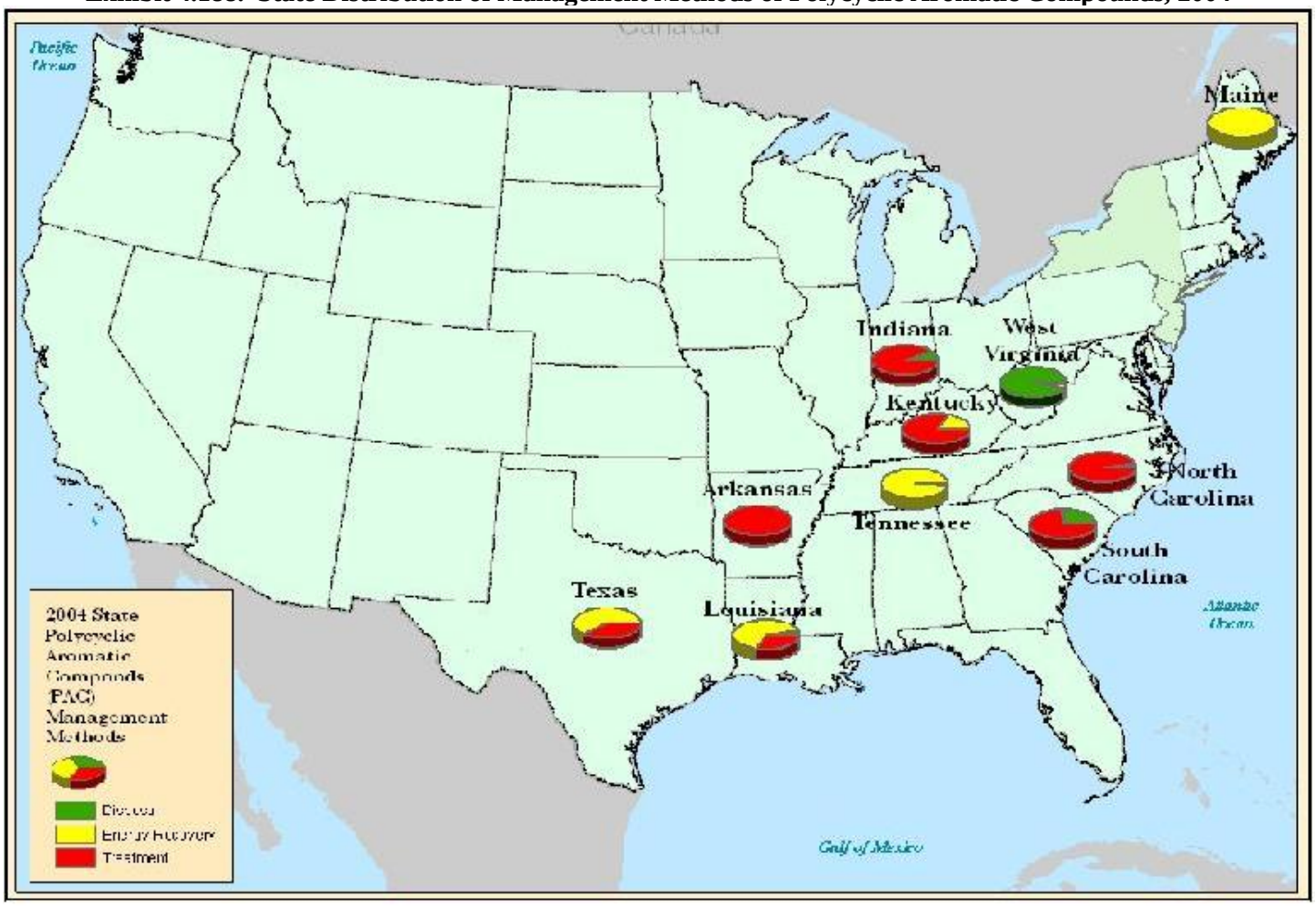


Exhibits 4.187 and 4.188 show how facilities in these 10 states managed PACs in 2004. Most of the facilities in these states used onsite energy recovery and/or onsite treatment for the majority of the PACs. Facilities in West Virginia land disposed most of the PACs; South Carolina facilities also land disposed a significant portion of the PACs quantity. Facilities in Texas, Louisiana, and South Carolina recycled approximately 700,000 pounds of PACs or approximately 84 percent of the total quantity of PACs recycled by facilities in these 10 states.

Exhibit 4.187. Management Methods for Polycyclic Aromatic Compounds, Facilities in States With 90 Percent of the Total Quantity, 2004

State	Total Quantity of PACs (2004)	Onsite Disposal (pounds)	Offsite Disposal (pounds)	Onsite Energy Recovery (pounds)	Offsite Energy Recovery (pounds)	Onsite Treatment (pounds)	Offsite Treatment (pounds)	Onsite Recycling (pounds)	Offsite Recycling (pounds)
TX	3,591,540	591	5,751	2,094,475	43,306	1,417,335	30,081	217,738	4,260
LA	2,357,586	1,084	98,774	1,492,092	1,065	757,022	7,549	64,769	233,228
TN	1,813,901	13,140	699	1,765,506	1,432	32,461	663	28,208	113
KY	1,696,087	6	8,528	299,136	1,268	1,380,968	6,181	6,329	498
AR	1,049,691	163	3,351	0	5,203	1,040,903	72	0	115
ME	519,741	105	421	518,380	21	808	5	0	0
IN	480,391	0	42,914	0	28	437,014	435	99,496	10
NC	357,623	106	7,991	0	501	348,646	378	15	162
WV	312,824	280	298,108	11	9,105	3,021	2,300	0	0
SC	257,494	151	63,008	0	5,118	184,548	4,669	179,606	27
Total	**12,436,877**	**15,627**	**529,544**	**6,169,601**	**67,047**	**5,602,725**	**52,333**	**596,160**	**238,415**

Exhibit 4.188. State Distribution of Management Methods of Polycyclic Aromatic Compounds, 2004



Industry Sector (SIC) Trends:

In 2000−2004, facilities in 133 industry sectors reported PACs; facilities in 86 of these industry sectors reported PACs in 2004. Exhibit 4.189 shows the quantity of PACs for the 10 industry sectors in which facilities reported 95 percent of these chemicals in 2004.

Compared to quantities reported in 2000, facilities in seven of these 10 industry sectors reported an increased quantity in 2004. Facilities in SIC 2911 (Petroleum refining) and SIC 2895 (Carbon black) reported two of the larger increases of 1 million pounds and 486,000 pounds, respectively. Conversely, facilities in SIC 3624 (Carbon and graphite products) and SIC 3334 (Primary aluminum) reported large decreases of 2.9 million pounds and 1.6 million pounds, respectively.

Compared to quantities reported in 2003, facilities in eight of these 10 industry sectors reported an increased quantity in 2004. These included increases of 818,000 pounds by SIC 3624 facilities and 247,000 pounds by SIC 2865 facilities. Most of the increased quantity for SIC 3624 was reported by a facility in Tennessee that uses coal tar pitch (containing PACs) for producing carbon electrodes. Increased processing of the coal tar pitch in 2004 resulted in increased quantities of PACs in wastes. Facilities in SIC 3312 (Blast furnaces and steel mills) reported a decrease of approximately 89,000 pounds. Most of this decrease occurred because a facility in Pennsylvania reported "normal" quantities of PACs following an increase in 2003 that resulted from cleaning tanks, clean−ups, and off−spec coke oven tar.

Exhibit 4.190 shows how facilities in these 10 industry sectors managed PACs in 2004. Facilities in these 10 industry sectors used onsite treatment and/or onsite energy recovery to manage approximately 91 percent of the total PACs quantity. In seven of the 10 industry sectors, these were the primary management methods for PACs. Facilities in three of these industry sectors: SIC 2865 (Cyclic crudes and intermediates), SIC 3011 (Tires and inner tubes), and SIC 3312 (Blast furnaces and steel mills) primarily used offsite disposal for PACs. In 2004, facilities in these 10 industry sectors recycled almost 1 million pounds of PACs. Facilities in four industry sectors (SICs 3334, 3312, 2911, and 3624) reported approximately 91 percent of the recycled quantity.

Exhibit 4.189. Industry Sectors Containing Polycyclic Aromatic Compounds, (Facilities Reporting 95 Percent of the Total Quantity), 2004

Primary SIC	SIC Description	Number of Facilities That Reported PACs (2004)	2000 (pounds)	2001 (pounds)	2002 (pounds)	2003 (pounds)	2004 (pounds)	Change in Quantity (2000−2004)	Percent of Total Quantity of This PC (2004)
2895	Carbon black	19	3,708,379	3,417,056	3,879,720	4,008,847	4,193,938	485,559	30.4%
3624	Carbon and graphite products	18	6,415,783	4,292,839	1,753,730	2,723,779	3,541,485	−2,874,298	25.6%
2911	Petroleum refining	82	656,118	878,206	2,663,901	1,649,597	1,683,041	1,026,923	12.2%
3334	Primary aluminum	13	3,123,285	1,798,358	1,394,522	1,436,079	1,559,987	−1,563,298	11.3%
2865	Cyclic crudes and intermediates	7	488,224	414,759	518,982	239,008	485,559	−2,666	3.5%
2992	Lubricating oils and greases	3	356,394	318,494	421,399	444,658	457,270	100,876	3.3%
2037	Frozen fruits and vegetables	1	0	345,565	386,531	381,671	377,822	377,822	2.7%
3011	Tires and inner tubes	46	204,787	263,445	173,853	251,153	352,590	147,803	2.6%
2824	Organic fibers, noncellulosic	5	5,008	26,975	87,238	183,822	206,106	201,097	1.5%
3312	Blast furnaces and steel mills	6	20,928	21,963	14,585	279,226	189,972	169,044	1.4%
	Total	**200**	**14,978,906**	**11,777,659**	**11,294,461**	**11,597,839**	**13,047,770**	**−1,931,136**	**94.5%**

Exhibit 4.190. Industry Sector Management Methods for Polycyclic Aromatic Compounds, (Facilities Reporting 95 Percent of the Total Quantity), 2004

Primary SIC	SIC Description	Total Quantity of Polycyclic Aromatic Compounds (2004)	Percent of Total Quantity (2004)	Disposal (pounds)		Energy Recovery (pounds)		Treatment (pounds)		Recycling (pounds)	
				Onsite Disposal	Offsite Disposal	Onsite Energy Recovery	Offsite Energy Recovery	Onsite Treatment	Offsite Treatment	Onsite Recycling	Offsite Recycling
2895	Carbon black	4,193,938	30.4%	418	6,497	3,555,521	0	631,269	233	0	0
3624	Carbon and graphite products	3,541,485	25.6%	13,055	18,407	2,064,653	65	1,443,983	1,322	182,306	498
2911	Petroleum refining	1,683,041	12.2%	4,268	14,771	103,990	71,163	1,473,839	15,010	227,081	1,472
3334	Primary aluminum	1,559,987	11.3%	1,084	25,562	0	0	1,531,914	1,427	273,057	0
2865	Cyclic crudes and intermediates	485,559	3.5%	0	404,136	70	76,883	608	3,862	6,956	28,500
2992	Lubricating oils and greases	457,270	3.3%	0	28,635	0	0	428,635	0	0	0
2037	Frozen fruits and vegetables	377,822	2.7%	0	0	377,822	0	0	0	0	0
3011	Tires and inner tubes	352,590	2.6%	159	347,435	0	3,497	0	1,500	994	2,279
2824	Organic fibers, noncellulosic	206,106	1.5%	3	10	77,251	0	128,841	0	0	0
3312	Blast furnaces and steel mills	189,972	1.4%	0	138,817	0	0	51,118	37	190,403	58,000
	Total	**13,047,770**	**94.5%**	**18,986**	**984,272**	**6,179,307**	**151,607**	**5,690,207**	**23,391**	**880,797**	**90,749**